

# Math Attitudes in Undergraduate Students Enrolled in Introductory Geoscience Courses

Molly M. Jameson<sup>a</sup>, Julie M. Sexton<sup>b</sup>, Dina R. London<sup>a</sup>, Jennifer M. Wenner<sup>c</sup>

<sup>a</sup>University of Northern Colorado <sup>b</sup>University of Colorado Boulder <sup>c</sup>University of Wisconsin, Oshkosh



## PROJECT OVERVIEW

- Women are underrepresented in geoscience.
- Math is one barrier to female student selection and persistence in various science disciplines.
- Math skills interventions and math attitudes interventions increase student math performance in science classes and improve student persistence in science.
- Few studies have examined the role of math as a barrier for female students in geoscience.
- Project Goal: to broaden participation of undergraduate female students by increasing their performance in geoscience courses and improving their persistence in the geoscience major. To accomplish this goal, we will do the following:
  - Objective 1: Develop and implement math skills and affective domain interventions in geoscience classes.
  - Objective 2: Research the impact of interventions on students' performance in geoscience classes and persistence in geoscience.

## POSTER FOCUS & RESEARCH QUESTIONS

- This poster focuses on Project Objective 2.

### Quantitative Study and Research Questions

- Due to limited research on math as a barrier for women in geoscience, we collected survey data to examine the role of students attitudes toward geoscience and math.
- Research questions:
  - What is the relationship between math anxiety, math self-efficacy, geoscience self-efficacy, and geoscience interest?
  - If there are significant relationships, are there gender differences in these relationships?
  - Which of these variables significantly and uniquely predicts students' geoscience interest?
  - Are there gender differences in the prediction of geoscience interest?

### Qualitative Study and Research Questions

- We examined student narratives about their attitudes toward math.
- Research questions: What are university geoscience students' attitudes about math? How do students' attitudes about math vary by gender?

## FUNDING & CONTACT INFORMATION

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 PI: Julie Sexton, Ph.D., [julie.sexton@colorado.edu](mailto:julie.sexton@colorado.edu)  
 Co-PI: Molly M. Jameson, Ph.D., [molly.jameson@unco.edu](mailto:molly.jameson@unco.edu)



## STUDY METHODS

We conducted a multi-methods research study as part of a larger intervention project. We collected baseline quantitative survey data and student responses to an application activity of the intervention on math anxiety.

### Quantitative Student Sample, Data Collection, and Analysis

- 245 undergraduate students enrolled in introductory geoscience courses across three colleges/universities across three semesters. 48% women, 9% gender minority; 64% white, 12% Latinx, 7% Black, 6.5% no response; 95.4% US resident students; 25.7% first-generation status; 4.5% declared geoscience major
- Pre-intervention surveys were administered to students enrolled in introductory geoscience courses: geoscience interest, geoscience self-efficacy, math self-efficacy, and math anxiety.
- Analysis: Correlational analyses were conducted to investigate the relationships among factors. Hierarchical regression was completed to explore whether and how these factors predict students' geoscience interest.

### Qualitative Student Sample, Data Collection, and Analysis

- Subset of students from the quantitative sample: 77 undergraduate students at two universities: 58% women, 1% gender minority; 62% white, 13% Latinx, 13% multiracial, 4% Black, 3% Asian, 3% no response, 1% American Indian, 1% Middle Eastern/North African; 96% US resident students; 25% first-generation status, 1% declared geoscience major.
- Data: short written math narratives students created during a lesson we developed on math anxiety. Students wrote about their attitudes and experience with math.
- Analysis of students' written math narratives through 2-cycle analysis with descriptive coding followed by thematic coding.

## RESULTS

### Quantitative Results

- Math anxiety, math self-efficacy, geoscience self-efficacy, and geoscience interest are significantly related to one another, particularly for women.
  - Students with high math anxiety and low math efficacy are more likely to have low geoscience efficacy and interest.
  - These relationships are stronger for women students than for men.
  - The table below shows the correlation between all study variables.

Comparison of Correlations Between All Study Variables By Gender

	Math Anxiety	Math Self-Efficacy	Geoscience Self-Efficacy	Geoscience Interest
Math Anxiety	-	-.306*	-.407**	-.174
Math Self-Efficacy	-.517**	-	.356**	.128
Geoscience Self-Efficacy	-.452**	.470**	-	.335**
Geoscience Interest	-.249	.349**	.437**	-

Note. The results for women are shown below the diagonal. The results for men are shown above the diagonal.  
 \*significant at  $p=.001$ ; \*\*significant at  $p<.001$

- A hierarchical regression showed that geoscience self-efficacy is the strongest predictor of geoscience interest for all students, math self-efficacy is a significant predictor of for interest, only for women.

### Qualitative Results

- Students' attitudes about math had three components: feelings, thoughts, and physiological reactions. Student responses for these components were positive (+) or negative (-) (see the table below).
- The intersection of students' feelings, thoughts, and physiological reactions defined three integrated math attitudes: **Thriving, Persisting, and Agonizing**.
- **Thriving** students had predominantly positive feelings and thoughts and no physiological reactions.
- **Persisting** students had positive and negative feelings and thoughts and a few negative physiological reactions.
- **Agonizing** students had predominantly negative feelings and thoughts and negative physiological reactions.

Table shows if students had positive or negative feelings, thoughts, and physiological reactions for the 3 integrated math attitude category.

	Thriving	Persisting	Agonizing
Feelings	+	+ and -	-
Thoughts	+	+ and -	-
Physiological Reactions	None	-	-

### Gender Differences.

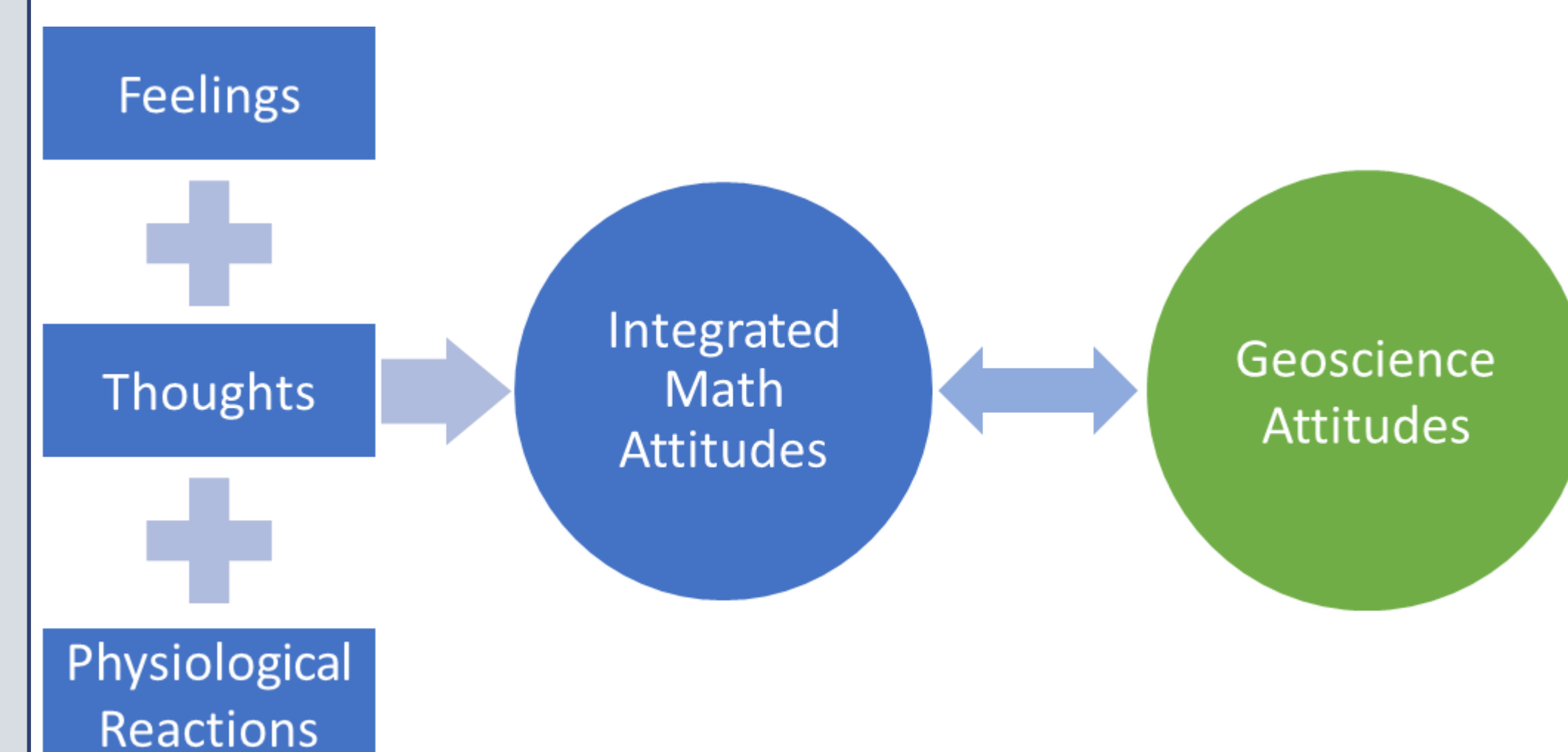
- A higher percentage of men were in the Thriving category (9% women, 21% men).
- A similar percentage of women and men were in the Persisting category (44% women, 48% men).
- A higher percentage of women were in the Agonizing category (47% women, 31% men).

## SUMMARY & IMPLICATIONS

### Summary

- Quantitative results also show an association between math attitudes and geoscience attitudes, particularly in women.
- Qualitative results show that students' math attitudes are complex and an integration of feelings, thoughts, and physiological reactions.
- The figure below shows a conceptual framework for the research findings.

Conceptual Framework of Findings: Feelings, thoughts, and physiological reactions intersect and define integrated math attitudes. Integrated math attitudes are associated with geoscience attitudes.



### Implications

- These findings can guide instructional interventions to reduce math as a barrier to student success in college-level geoscience classes.
  - The significant relationship between math attitudes and geoscience attitudes suggest that geoscience instructors should consider how their students feel and think about math in their geoscience courses.
- These findings also shed light on math as a barrier for women in geoscience.
  - The important role of math self-efficacy in geoscience interest for women, but not for men, suggests that math attitudes serve as a relevant barrier for female students.
  - Higher percentages of women categorized as having an agonizing math attitude along with lower percentages of women having a thriving math attitude suggest that targeting math attitudes of women may serve as an effective tool to transform math beliefs and math success.

## REFERENCES

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